CHAPTER

9

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GENERAL

CAD is the most common method used to prepare bridge plans; however, manual drafting is sometimes utilized to produce bridge details. The instructions given in this chapter are sometimes only applicable to one of the two methods of plan preparation. Many of the principles necessary to produce quality bridge apply to both the manual and the computer aided method.

The purpose of an engineering or technical drawing is to convey complete instructions with clarity and simplicity. Complex projections, excessive detail, artistic flourishes and other unnecessary drafting frills should be avoided. They add nothing to the value of the drawing and defeat the objectives of simplicity and clarity that are so important to the plan production process. Show only what is necessary to clearly describe the detail.

A good quality drawing is easily recognized by its clean appearance, sharp line work, clear and uniform lettering, well-selected views and simple presentation. The importance of careful presentation cannot be over-emphasized as a prime factor in contributing to good quality reproductions. One cannot expect to achieve the same good results with a soiled, wrinkled drawing with light lines and lettering that one can with a clean drawing, using black opaque lines and lettering.

INSTRUCTIONS IN DETAILING FOR REDUCTION OF PLANS

The Louisiana Department of Transportation and Development has a policy of reducing all plans that are to be let to contract. This process means that the drawings are reduced, using photography, to a plate 50 percent smaller than the original. Because this reduction works both horizontally and vertically, a plan sheet approximately one-fourth the size of the original plan sheet will result. The result is not always completely satisfactory in that the line work on the reduction may appear somewhat "fuzzy" or light if care is not used in preparing the drawings. These reduced prints will be the plans from which the contractor computes his bid and will also be used for construction of the bridge. Within a reasonable time after the bridge has been constructed, the original sheets will be microfilmed to one-thirteenth of the original size and kept as a permanent record of the contract plans. Prints can be made at any time in the future from the microfilm if it becomes necessary to do additional work on the bridge. Legibility is clearly of great importance.

What is considered "normal detailing practice" may not always apply to drawing that is to be reduced. This task requires a constant awareness on the part of the drafter, who should consider the question, "How will this drawing appear when it is reduced?" The size of lettering, spacing between lines of lettering, and spacing between object lines are all affected by plan reduction. The drafter should pay close attention to these concerns; otherwise, the plans will not be suitable for reduction. One must conclude that drawing plans for reduction requires not only technical skill, but an attention to detail not necessary when drawing for full-size reproductions.

LETTERING

Due to nature of engineering work and the time element involved, it is often necessary to employ more than one drafter in the preparation of the plan sheets that go together to make up a final set of contract drawings. Such a procedure dictates that drafting practices should be consistent to ensure a reasonably uniform appearance for all sheets in the plan set. The greatest source of inconsistency is in the plan lettering. No two drafters will letter exactly alike, but if both are using the same basic style, then the result should be generally suitable. When work is being done on a drawing that has lettering already on it, whether it is hand type, Leroy, or other mechanical means, every effort should be made to match the additional lettering to the existing lettering on that sheet. All letters and numbers shall be created with an open, non-compressed style. The prints generated from microfilm or half-size copies are reduced from the original size, making clear, open lettering, uniform and properly spaced, essential for legibility. Lettering shall be vertical style, uppercase lettering, however, slanted lettering will not be prohibited for hand lettered drawings or drawings produced prior to this publication. Some type of guideline system shall be used, either a mechanical lettering guide or a prepared guideline sheet. Freehand lettering should never be attempted without using guidelines.

The body of letters, numbers, and symbols shall be no smaller than 140 Leroy size, except in unusual cases where available space is inadequate. If lettering is reduced to a size smaller than 140 Leroy, it must be reasonably readable at 50% reduction. The 120 Leroy size will usually meet these criteria. See the examples below for the size and type of lettering required. Sizes indicated as minimum are also the recommended sizes for most applications.

SCALE

Drawing scale is an important consideration when setting up a detail sheet. Scales should be appropriate for the application, not too big and not too small. Legibility is the key consideration. Small-scale, crowded plans, elevations, views, and sections are not acceptable, so consideration should be given to moving views and sections to other sheets, separate from plan and elevation views, when necessary to avoid overcrowded and under-scaled details. Materials lists, summary of quantities and large notes may also be placed on separate sheets.

Obviously it is difficult to make proper topography drawings and plan-and-profile sheets to a large scale without utilizing additional time and materials; however, it is possible to greatly clarify a drawing without enlarging the scale by careful placement of dimensions, descriptions, and notes.

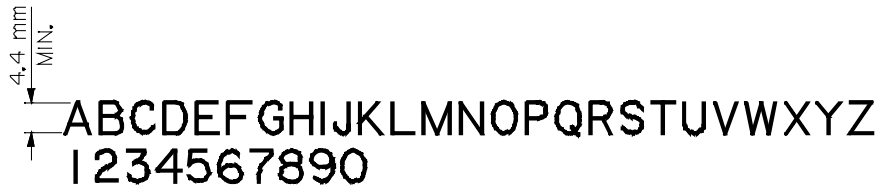
Details shall be drawn to standard scales where practical. If the detail is to scale, show the scale under the detail title. In special cases a detail may be scaled to fit available space. In these cases indicate that details are not to scale by noting "NTS" below the sheet title. Traditionally certain details, such as reinforcing bar details and superelevation transition details, have been drawn in schematic format. It is not necessary to mark schematic details "NTS."

TEXT

PEN AND PENCIL TEXT SIZE AND LINE WEIGHTS

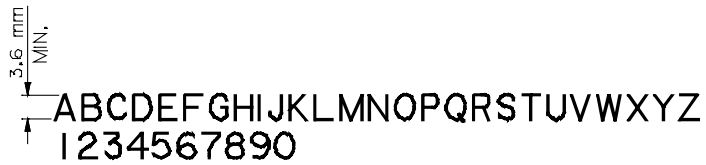
Detail Titles

Lettering Guide - # 5 1/2 Ames or # 175 Leroy
Line Weight - H lead or # 2 Technical pen



Dimensions, Notes and Callouts

Lettering Guide - # 4 1/2 Ames or # 140 Leroy
Line Weight - 2H lead or # 1 Technical pen



CAD TEXT EQUIVALENCE

Text heights shown above are equivalent to the Leroy size or guideline spacing indicated, and are measured to the outside of stroke, whereas CAD text heights are measured to center of stroke. Therefore, a reduction in CAD text height values from the text heights shown above is required to achieve equivalent CAD text output. CAD text height values are as follows: 3.2 mm for 140 Leroy equivalence and 4.0 mm for 175 Leroy equivalence. CAD lines for text shall be equal in width to the technical pen specified above.

LINE WORK

To ensure good half-size and microfilm reproductions, lines must be properly drawn. Ink is recommended as the best reproducing agent, however, dark concise pencil lines are acceptable. The outline of the object should stand out sharply, with reinforcing lines somewhat less prominent. Dimension lines, centerlines, cross-hatching, and existing structure lines shall be lighter still. Guidelines shall be scarcely visible. Closely drawn lines should be avoided as they tend to run together to make one (1) heavy line when the drawing is reduced. Some exaggeration of scale may be used in areas where this might occur. Lines of any type should never be placed on the back of drawings because they are almost impossible to reproduce with LA DOTD methods.

A steady pressure should be exerted to ensure lines of constant density throughout the drawing. Consistent line width and black opacity are essential. When making changes on a drawing, every effort should be made to match the original line density. A good gauge of the opacity of pencil line is whether it shines or not. A black shiny line will reproduce much better than a dull, fuzzy one.

PEN AND PENCIL LINE WORK

1. Object or Concrete Lines (# 2 Technical Pen or 2H Lead - Minimum)
2. Reinforcing Steel or Metalwork Lines (# 1 Technical Pen or 3H Lead - Minimum)
3. Hidden Lines (# 0 Technical Pen or 3H Lead - Minimum)
4. Ground Lines (# 0 Technical Pen or 3H Lead - Minimum)
5. Dimension Lines and Arrow Heads (# 00 Technical Pen or 4H Lead - Minimum)
6. Centerlines (# 00 Technical Pen or 4H Lead - Minimum)
7. Existing Features Lines (# 00 Technical Pen or 4H Lead - Minimum)
8. Cross-Hatching (# 00 Technical Pen or 4H Lead - Minimum)
9. Break Lines (# 00 Technical Pen or 4H Lead - Minimum)
10. Cutting Plane or Section Lines (# 3 Technical Pen or H Lead - Minimum)

CAD LINE WORK EQUIVALENCE

CAD lines shall be equal in width to the technical pens specified above. Software pen widths shall be adjusted to ensure a match that is as close as possible.

BRIDGE DESIGN CAD STANDARDS

The following requirements assume that details are generated with MicroStation software. Currently submittal of consultant plans is not required in electronic format; however, this may become a requirement in the future. Users of other software should read this section as a guide to output symbology and quality expectations, and the general types of standardization expected.

CELL FILES

Cell files are indexed graphically in the Bridge Design Cell Libraries booklet. This is a separate document and may be obtained upon request from the Bridge Design Section. Bridge Design cell libraries are as follows:

ENGLISH	METRIC
common.cel	general.cel
bent.cel	struct.cel
span.cel	struct.cel
gp.cel	plan.cel
steel.cel	metal.cel
mec.cel	mech.cel
ele.cel	elect.cel

Cell libraries are useful because they enable frequently used details to be accessed in a standardized format and placed without having to redraw. The above cell files should be used whenever possible by Bridge Design drafters. Personal versions of Standard Bridge Design cells are not recommended. Individuals creating useful cells should see to it that these cells are included in the appropriate cell library, and make sure that the library keeper is informed. Cells should be carefully constructed. Cells of limited long-term value, such as those to be used on a specific job only, shall be included in personal or project cell libraries. Consultants will not be required to use Bridge Design cell libraries; however, they should strive to achieve similar standardized details. Bridge Design cell libraries will be made available to consultants upon request.

TEXT REQUIREMENTS

Fonts: Text shall be Font 103, a vertical, open, non-compressed style similar to Leroy. All text shall be uppercase unless there is a special need for lowercase such as the metric symbol, “mm.” Actual text sizes shall be equal to mechanical Leroy sizes. For consistency and convenience, it is recommended that the sidebar menu, bridge-m.sbm, be used to set text size, line spacing and line weights.

FILE NAMING CONVENTIONS

Users of Windows NT, Windows 95 or Macintosh operating systems may take advantage of the long filename capability. The filename “Bents2-5wb.dgn,” for instance, is permissible; however, filenames that are overly descriptive are not recommended. A keyword, such as “Bent” or “Span,” should start long filenames so that they will be grouped properly in the file manager.

Users of DOS or Unix type operating systems or mixed systems including either of these should use filenames conforming to DOS conventions. Maximum length of DOS filenames is 8 characters + 3 character extension. DOS filenames are permissible for all common operating systems. Unix allows two additional characters, but this is not enough to enable useful long filenames. A detail representative of several elements in a design, such as "bents 2-5 and 9", shall be specified using the first element number (i.e., bpil2.dgn). Standardized DOS filenames are listed below.

Files shall be limited to one sheet each. Filenames for details that require more than one sheet, such as end bents, shall be given a letter designation (e.g., bpil1a.dgn and bpil1b.dgn). Standard plan files shall be named according to historical conventions. The standard design file extension is ".dgn" and shall be used except where specified otherwise.

Mechanical and Electrical Filenames

Files shall be named according to the "M" or “E" number whenever applicable. Examples: M04.dgn and E07.dgn.

Structural Filenames (DOS convention)

1.	**GENERAL ITEMS**
FILENAME	DESCRIPTION
plangb.dgn	plan, general bridge
plangr.dgn	plan, general ramp
plangd.dgn	plan, general detour bridge
channel.dgn	channel relocation and improvements
laygen.dgn	layout, general
layseq.dgn	layout , sequencing or phasing
notes.dgn	general notes
qsum.dgn	quantities, summary of
qbrsum.dgn	quantities, bridge summary of
signp.dgn	signing, permanent
signc.dgn	signing, construction
eltb.dgn	elevation table

2.	BRIDGE SUBSTRUCTURE
FILENAME	DESCRIPTION
layfnd.dgn	layout, foundation
col.dgn	columns
drshaft.dgn	drilled shaft
pierprt.dgn	pier protection (fender system, dolphin, etc.)
fender.dgn	fender system
footing.dgn	footings
bgate.dgn	bent with traffic gates for movable bridge
bpier.dgn	bent, pier
bcol.dgn	bent, column
bpil.dgn	bent, pile
btbar.dgn	bent with traffic barrier for movable bridge
bppier.dgn	bent, pivot pier
pilepc.dgn	pile, precast
pilest.dgn	pile, steel
pileti.dgn	pile, timber
pilett.dgn	pile, treated timber
pidattb.dgn	pile data table

3.	**BRIDGE SUPERSTRUCTURE**
FILENAME	DESCRIPTION
planf.dgn	plan, framing
super.dgn	superelevation transition
railhn.dgn	rail, handrail
railbr.dgn	rail, barrier
wallrtn.dgn	wall, retaining
floorgr.dgn	flooring, grid
gicb.dgn	girder, concrete box
gicsb.dgn	girder, curved steel box
gicsi.dgn	girder, curved steel I-beam
gippc_.dgn	girder, ppc (type), e.g., gippc3 = type 3
gisi.dgn	girder, steel I-beam
gisb.dgn	girder, steel box
gidgntb.dgn	girder design table
gilentb.dgn	girder length table
ssi.dgn	span, steel I-beam girder
sppcb.dgn	span, precast-prestressed concrete box girder

3.	BRIDGE SUPERSTRUCTURE
sppci.dgn	span, precast-prestressed concrete I-girder
scslab.dgn	span, cast-in-place slab
spslab.dgn	span, precast slab
sctb.dgn	span, cast-in-place T-beam
slift.dgn	span, lift
sswing.dgn	span, swing
sccb.dgn	span, cast-in-place concrete box girder
sptcb.dgn	span, post-tensioned concrete box girder
sptci.dgn	span, post-tensioned concrete I-girder
ssb.dgn	span, steel box girder
postdet.dgn	post-tensioning details
postlay.dgn	post-tensioning layout
postqnt.dgn	post-tensioning quantities

4.	BRIDGE APPROACHES
FILENAME	DESCRIPTION
appr.dgn	approach slab
apprps.dgn	approach slab, pile supported

5.	SPECIALTY ITEMS
FILENAME	DESCRIPTION
access.dgn	access opening
caisson.dgn	caisson
cntwt.dgn	counterweight
drainbr.dgn	drainage, bridge
drainsc.dgn	drain, scupper
deckco.dgn	deck coordinates
erctsch.dgn	erection scheme, casting machine schematic
jtexp.dgn	joint, expansion and stress relief joint
jtfng.dgn	joint, finger
jacking.dgn	jacking details
operh.dgn	operator house
portal.dgn	portal
bearn.dgn	bearing, neoprene
bearp.dgn	bearing, pot
bearr.dgn	bearing, rocker

5.	SPECIALTY ITEMS
beart.dgn	bearing, Teflon
segbulk.dgn	segment bulkhead
seg.dgn	segment details
seglay.dgn	segment layout
strut.dgn	strut
subshaft.dgn	subshaft
tower.dgn	tower
portalt.dgn	portal, tower
truss.dgn	truss
swbrace.dgn	sway bracing
willowm.dgn	willow mattress
windanc.dgn	wind anchorage
windlnk.dgn	wind link

SEED FILE SETTINGS

SETTING CATEGORY	SETTING TYPE	ENGLISH FILE SEEDBDE	METRIC FILE SEEDBDMD	METRIC FILE SEEDBDMP
1. Text	font size space	103 0.1280 0.0768	103 96.0 58.0	103 0.960 0.576
2. Working unit names	master units sub units	‘ “	blank (mm) blank	_m blank (mm)
3. Resolution	sub units positional units	12 8000 or 2000	1 80	1000 80
4. Coordinate Readout	coord. format ang. accuracy angle format angle mode ang. accuracy tpmode	master .1234 dd.dddd conventional .1234 delta	master .12 dd.dddd conventional .1234 delta	master .1234 dd mm ss bearing 0.1 seconds delta
5. Cells	cell library terminator cell	common.cel LT101	bridge.cel LT101A	bridge.cel LT101A
6. Grid	master grid reference grid	0.0833 12	0.1 10	1.0 10
7. Level names	level name file	str.lvl	str.lvl	str.lvl
8. Dimensions	as in settings file component	str.stg english detail	str.stg metric detail	str.stg metric plan
9. Sheet type	reference file sheet cell	N/A sh101n	detsheet N/A	plnsheet N/A

Note: Settings not shown are generally as in seed2d.dgn.

OUTPUT QUALITY - NEATNESS AND COMPOSITION

CAD affords a great opportunity to produce neat, well-composed drawings. Details can be corrected, revised, rearranged, moved, copied, scaled, and rotated with little difficulty. Object corners can be made to meet precisely with zero gap or overlap. Spacing between lines of text can be made consistent. Automated dimensioning enables consistent dimension styles. Symbology settings enable consistency in drawing appearance and readability. There is simply no excuse for shoddy work.

ACCURACY GUIDELINES

The value of CAD drawings can be greatly extended if they are accurately drawn. Precise angles and distances can be derived directly from CAD drawings without unnecessary additional manual or cogo computation. For this reason drawing geometry shall be input with six decimal place accuracy (meters) and three decimal place accuracy (millimeters). Small design dimension changes or input errors sometimes have ramifications to the drawing as a whole that would require a disproportionate amount of time to fix. In this case, if there is no critical geometry to be derived from the drawing, corrections need not be made to the geometry. Conversely, if corrections to the accuracy of drawing geometry can be easily made, they should be made.

In the past MicroStation has not been able to generate drawings with geometric accuracy that rivals hand calculations or cogo program output. Effective with MicroStation SE, an "enhanced precision" option is available which provides accuracy superior to double-precision floating-point storage. This option is invoked for Bridge Design effective April 1, 1999. It will not affect the accuracy of previously drawn geometry.

CAD TOOL CHOICES

As any experienced CAD operator knows, there are often many ways to get the job done. A dimension, for instance, can be drawn using separate lines, terminators and text as was necessary with now archaic software such as the IGDS system. Dimensions can now be placed as dimension elements using dimensioning tools with associated standard saved settings for symbology and formatting. Dimensioning tools can often cut time required for dimensioning by well over 90%. These tools can be frustrating to deal with in unusual situations, but the efficiency gained is well worth the time required to learn how to deal with such situations.

CAD operators must take the time to learn all applicable tools and keep updating their skills, as new tools become available. Not implementing new, more effective tools will cost considerable time, effort and money in the long term. Change is inevitable, so taking full advantage of the tools that are provided is imperative. Staying with the old, familiar ways is simply unacceptable. For this reason, if a checker notices the use of an archaic tool in design file creation, he/she should suggest more efficient methods.

STANDARDIZATION IMPORTANCE

Effective with the implementation of the Metric System is a renewed emphasis on standardization of detailing practices. With manual drafting, the primary elements of standardization are lettering style, symbolization, line style, and line weight. With CAD drafting, the elements of standardization are more complex. The additional elements of level structure, color, element type, cells, reference files, preference files, configuration files, seed files, etc. have added to the possibility of inconsistency. Standardization of these CAD elements has often been spotty to non-existent. This is not acceptable.

One of the biggest advantages of CAD is the ease with which details can be modified, corrected or copied for use in other jobs. When a detail is copied for a new job, alterations are often needed to make it fit the situation. Often the job of correcting a drawing or altering it for a new job falls on a drafter other than the original one. This can be a frustrating experience for the new drafter. Basic environmental issues come into play. If seed file settings are non-standard (e.g., working unit format, dimensioning settings, etc.), they must be set properly. If colors and levels are non-standard, then the drafter must get used to them or undertake the time consuming task of correcting element attributes. If the drawing is inaccurate or non-standard, is it worth fixing? If it is not worth fixing, do I want to make-do and put my name on it? Maybe I should just start over.

Working in another person's drawing file can be likened to working in another person's office. Some kind of order and familiarity is necessary or inefficiency and discomfort will result. For this reason the standards presented in this chapter must be taken seriously.

INROADS OUTPUT REQUIREMENTS

Project requirements generated through the InRoads roadway design software shall meet standards developed by the Road Design Section unless specified otherwise.

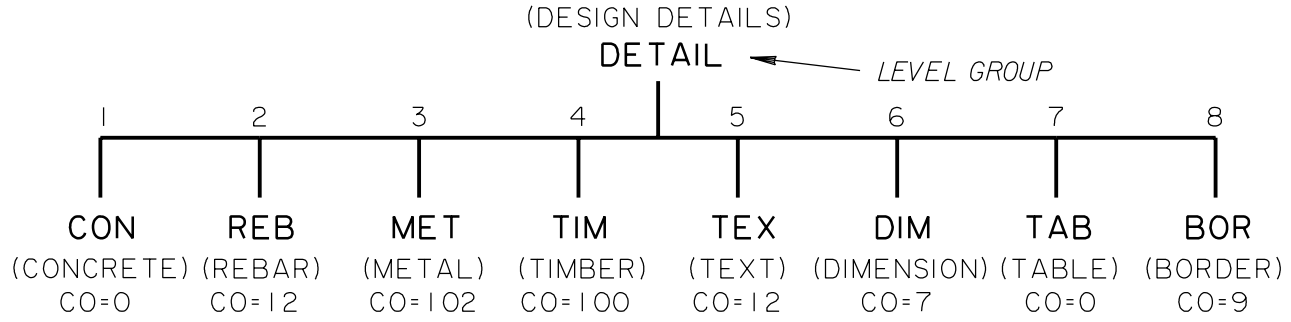
SURVEY DESIGN FILE TREATMENT

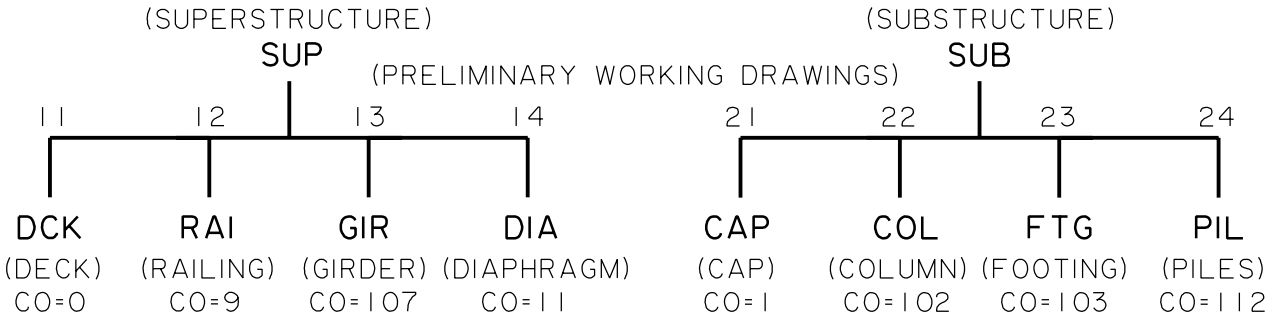
Where survey data is to be part of a design, it shall be attached to the plan sheet as a reference. This reference file or reference view is an overlay to the design and is manipulated using clip bounding, clip masking and level display combinations.

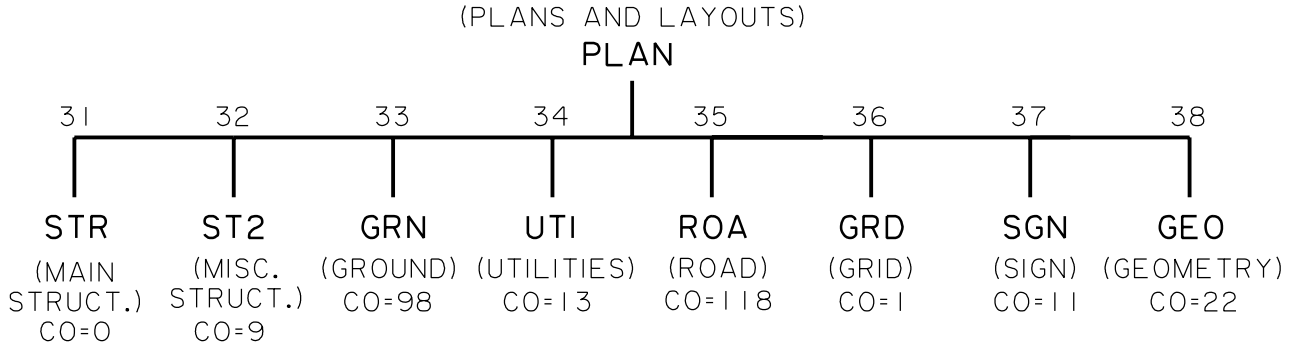
SPECIAL CONSULTANT REQUIREMENTS

Any special requirements for consultant jobs will be included in the contract or communicated through the project coordinator.

Occasionally, a consultant may be required to furnish drawings in MicroStation format, such as when the Department and one or more consultants share a job. In such cases the consultant should contact the Department, preferably before starting to detail the plans, to obtain information necessary for successful translation. This may include information such as font names, character mapping information and drawing symbology standards.





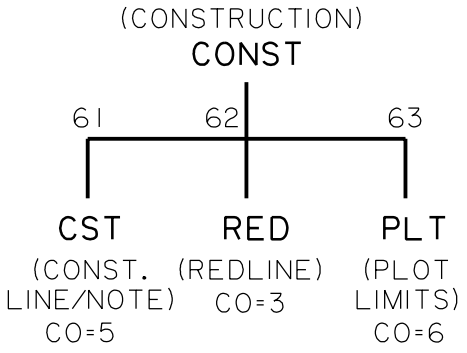


NOTES:

STANDARD SEED FILES CONTAIN LEVEL STRUCTURE. WHEN USING DESIGN FILES NOT CREATED FROM SEED FILES, LOAD THE STRUCTURAL LEVEL STRUCTURE FILE, STR.LVL, AND SAVE SETTINGS. ADDITIONAL LEVELS FOR MECHANICAL, ELECTRICAL, ARCHITECTURAL OR OTHER ELEMENTS MAY BE ADDED AS NEEDED. SAVE MODIFIED LEVEL STRUCTURES TO A ".LVL" FILE IN THE PROJECT DIRECTORY IF STRUCTURE WILL BE USED AGAIN.

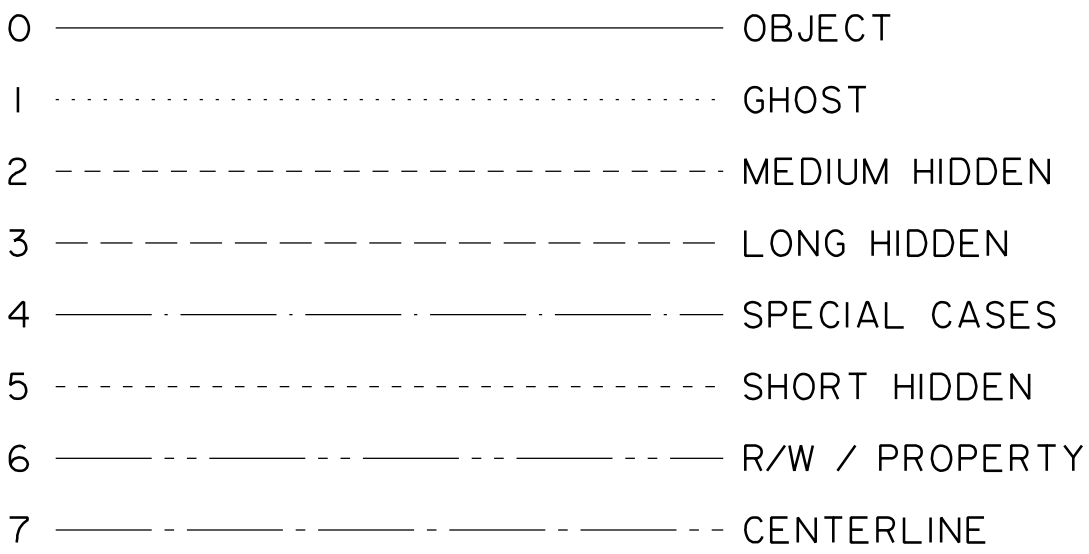
FOR CONSISTENCY AND CONVENIENCE, IT IS RECOMMENDED THAT THE SIDEBAR MENU, BRIDGE-M.SBM, BE USED TO SET LEVEL AND COLOR.

TOPOGRAPHY LEVELS SHALL BE AS ADOPTED BY THE ROAD DESIGN SECTION. TOPOGRAPHY SHALL BE REFERENCED TO THE PLAN SHEET.

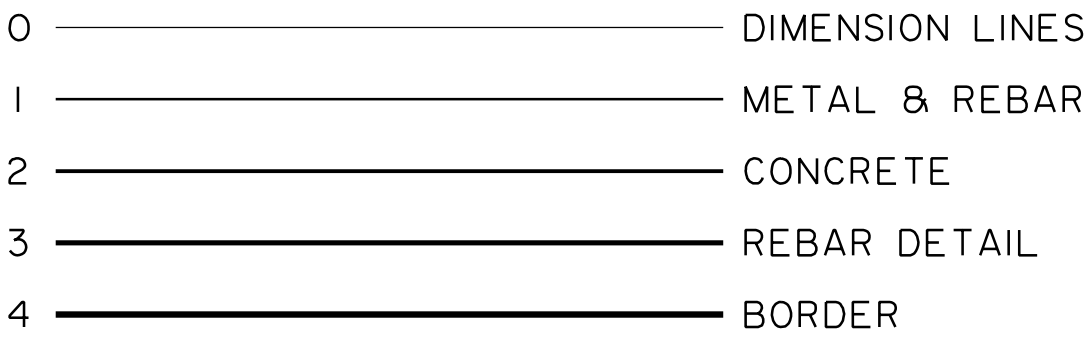


STRUCTURAL LEVELS

LINESTYLES



LINE WEIGHTS FOR TYPICAL DETAIL ELEMENTS



NOTES:

EXCEPTIONS WILL BE ALLOWED FOR SPECIAL SITUATIONS.

TOPOGRAPHY SYMBOLOGY SHALL BE AS ADOPTED BY ROAD DESIGN.
TOPOGRAPHY SHALL BE REFERENCED TO THE BRIDGE FILE.

FOR CONSISTENCY AND CONVENIENCE, IT IS RECOMMENDED THAT THE SIDEBAR MENU, BRIDGE-M.SBM, BE USED TO SET ELEMENT SYMBOLOGY.

LINE SYMBOLOGY

KEYBOARD:

ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz

@ # $ % & * ( ) + - = \ { } [ ] : " ; ' < > ? , . /

Φ (`) ϕ (~) △ (!) ° (^) ℄ (:) 1 2 3 4 5 6 7 8 9 0

FRACTIONS: ½ ¼ ⅛ 1/16 1/32 (ALL)

FORMAT FOR OTHER FRACTIONS = EXPONENT(S) / SUBSCRIPT(S) (/ = \250)

EXPONENT	
^{0}	\230
^{1}	\231
^{2}	\232
^{3}	\233
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•	\165
1	\167
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₱	\177
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⊠	\182
⌗	\183
◬	\184
⊡	\185
⊙	\186
◭	\187
⊡	\188
⊕	\189
✓	\252
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HISTORIC	
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△	\164
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HISTORIC IS FOR OLD DRAWINGS. USE KEYBOARD FOR NEW WORK.

KEYBOARD	
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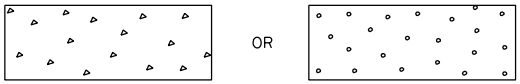
NOTE:
CHARACTERS ARE SHOWN AT FULL SCALE PLAN SIZE.

△ CHARACTER VERSION TO BE USED FOR SPECIAL CASES ONLY.

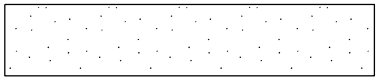
⊗ ALL BUG CHARACTERS ARE TWO SPACE CHARACTERS WIDE EXCEPT FOR BULLET WHICH IS ONE SPACE CHARACTER WIDE.

STANDARD HIGHWAY DESIGN FONT (FONT 103 CHARACTERS)

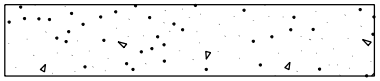
AGGREGATE SURFACING REQ'D.



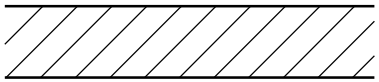
ASPHALTIC CONCRETE OR BITUMINOUS SURFACE TREATMENT REQ'D.



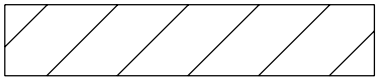
CONCRETE



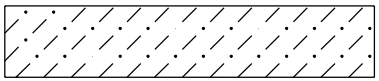
DRAINAGE EXCAVATION REQ'D.



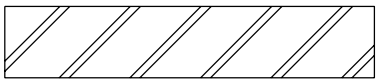
BRICK



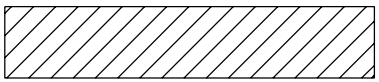
BRASS, BRONZE OR COPPER



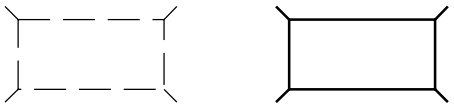
STEEL



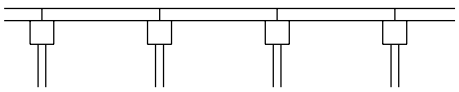
CAST IRON



BRIDGE IN PLAN



BRIDGE REQ'D. IN PROFILE

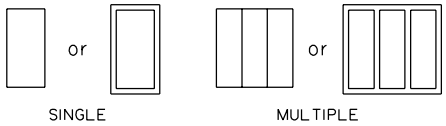


MANHOLE

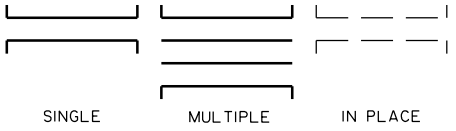
CATCH BASIN

CULVERTS REQ'D. IN PROFILE (PIPE)

CULVERTS REQ'D. IN PROFILE (BOX)



CULVERTS IN PLAN (PIPE OR BOX)



LAKE, POND, ETC.

RIVER, BAYOU, STREAM, ETC. (SMALL SCALE)

RIVER, BAYOU, STREAM, ETC. (LARGE SCALE)

CONVENTIONAL SYMBOLS

1 OF 3

CUTTING PLANE LINE	REINFORCING BARS STAGGER BREAKS
DIMENSION LINE	CONTROL OF ACCESS LINE
BREAK LINE	FENCE LINE
PROPERTY LINE	GATE OR WIRE GAP
RIGHT OF WAY	LEVEE TYPICAL SINGLE LINE RICE LEVEE
CENTERLINE OF PROJECT OR SURVEY ℄ 12+875 12+900 12+925	CABLES LETTER DENOTES USAGE (E.G. TV-TELEVISION; P-POWER; T-TELEPHONE, ETC.) TV TV
CENTERLINE (OTHER THAN ℄ PROJECT OR SURVEY ℄)	PIPE LINES LETTER DENOTES USAGE (E.G., G-GAS, W-WATER, ETC.) G G
HIDDEN LINE	SCALE AS SHOWN
LIMITS OF CONSTRUCTION LIMITS OF CONSTRUCTION	
GROUND LINE	

CONVENTIONAL SYMBOLS

2 OF 3

(91) 6

ROAD (EXISTING DIRT OR GRAVEL)

ROAD (EXISTING PAVED)

IN PLACE

TO REMAIN

TO BE REMOVED

RAILROAD

WATER STAGE

DWS ELEV. 16.50

SWAMP OR MARSH

SWAMP

MARSH

TREE

HEDGE

WOODS EDGE

BUILDING

3.72 m

1.78 m

GRAVE

GUY POLE

GUY WIRE AND ANCHOR

POLES

POWER

TELEPHONE

COMBINATION

FIRE HYDRANT

WELL

G

GAS

O

OIL

WATER

WATER VALVE

METER

GAS

WATER

RIGHT OF WAY MARKER

CONVENTIONAL SYMBOLS

3 OF 3

9 (17)

METRIC DETAILING CONVENTIONS

NUMBERS

The International System of Units (SI)

In accordance with The International System of Units, numbers shall be divided into groups of three separated by spaces on either side of the decimal. Do not use a space for four digit numbers except for uniformity in tables. Do not use spaces for monetary values and formulas. Commas shall not be used except for monetary values (e.g., "$3,000.00"). Include leading zero (e.g., 0.205).

Examples: 2 300 150 1234 4200.1234 44 200.123 45 625.22 0.205

Numbers in tables

If a table includes numbers with five digits or more, use spaces for consistency including all numbers of four digits or more so that columns line up properly. Otherwise, do not use spaces for four digit numbers.
Exception: Where tables are output by software that does not provide for unit separation by spaces, it is not necessary to edit to add spaces.

DIMENSIONS

Dimensions shall be in millimeters unless otherwise noted.

Special format guidelines

1. Include the unit symbol for **dimensions included in notes** (e.g., “450 mm DIAMETER PILE”). Exception: Omit unit symbols for plates (e.g., “PL 15x200”) and steel shapes (e.g., “L 102x102x9.5”). If length is shown, include the unit symbol (e.g., “L 102x102x9.5 x 800 mm”)

2. For **dimensions and callouts, where text is included**, include the unit symbol. Exception: The unit symbol may be omitted where space is a problem, if the meaning is clear. For example:

Normal:	"20 SPS. @ 300 mm = 6000 mm (B1501)"
Acceptable:	"20 SPS. @ 300 = 6000 (B1501)” to save space.
Not acceptable:	"20 300 SPS. = 6000 B1501"
Normal:	"13 200 mm CLEAR ROADWAY"
Acceptable:	“13 200 (CLEAR ROADWAY)" to save space.
Acceptable:	"13 200" above dimension line and "CLEAR ROADWAY" below dimension line to save space.
Not acceptable:	"13 200 CLEAR ROADWAY

3. For **dimension lines and callouts where dimension stands alone**, omit the unit symbol (i.e., "6025" implies "6025 mm").

4. "When indicating the **size of an object**, show the unit symbol once in sequence (e.g., “10 x 25 m SLAB”).

5. **Bolts, cap screws, studs and rods** shall be designated by the diameter preceded by the letter “M” (i.e., “M24” designates a metric 24 mm diameter bolt. Use only the standard metric diameters as shown in bolt data this chapter. Thread designations are normally covered by the Standard Specifications. Where length is shown, always include the unit designation, “mm” (e.g., “M24 x 300 mm bolt”).

6. **Industry standards for size designations**, such as those published by ASTM or a manufacturer, shall be implemented for items not addressed by this document.

7. Include a space before and after **small ”x”** (e.g. “M24 x 300 mm BOLT”). Exception: Omit spaces (except for length) for plates (e.g., “PL 15x200 x 800”) and steel shapes (e.g., “L 102x102x9.5 x 800”).

Exceptions to the millimeter standard

1. **Elevations, stations and survey curve data including PC and PT stations shall be expressed in meters**. Omit the "m" for stations and elevations. Examples: PC 22+850.320 PVI 23+150.320 ELEV. 23.872 R= 698.552 m

2. **Dimensions shown on general plans and general layouts shall be expressed in meters** (e.g., "20.710 m SPAN") except that pipe and pile diameters shall be expressed in millimeters (e.g., "600 mm x 60 m PIPE).

STATIONING

Stations shall be expressed in kilometer format (e.g., “STA. 13+750"). Where plus (+) stations are shown, they shall be relative to the kilometer (e.g., "+025" or "+750").
Major tics shall be shown at 100 meter intervals with minor tics at 25 meter intervals.

ACCURACY

Accuracy for proposed features including dimensions, stations and elevations will normally be to the nearest 1 mm or 0.001 m. Accuracy rules for other situations are indicated below:

1. All **ground line (profile) elevations** and associated stations shall be expressed with 0.01 m accuracy unless there is a need for greater accuracy. This includes existing pavement elevations.

2. **Topography location** (station, offset), where specified, shall be expressed in meters with 0.1 m accuracy (e.g., "+825.1, 45.1 m RT."). Use greater accuracy if necessary.

3. **Topography dimensions**, where specified, shall be expressed in meters with 0.01 m accuracy (e.g., "13.06 x 60.96 m CONCRETE BRIDGE"). Use greater accuracy if necessary.

4. **English system shapes designated in metric format** shall be according to ASTM A 6M (i.e., "L 102x102x9.5" describes "L 4x4x3/8").

5. **Gauge wire diameter and gauge plate thickness** shall be expressed with 0.1 mm accuracy.

6. **Survey angles, deltas and bearings** shall be expressed with 0.1" accuracy (e.g., "N 32°13'35.1" W"). This also applies to layout angles such as joint centerline angles.

7. **Detail angles**, such as for rebar bending and concrete forming, shall be expressed in decimal format with 0.0001° accuracy (e.g., "78.3042°").

8. **Mechanical dimensions** shall be expressed in millimeters. Accuracy required varies depending on the application.

If no decimal place is shown, then the normal accuracy for the situation is assumed (i.e., "50 m SPAN" is assumed to mean "50.000 m SPAN"). If the decimal is used, always include the specified number of decimal places for the situation.

Although 1 mm or 0.001 m is the normal accuracy for bridge details and stations, use increments of 10 mm or greater whenever possible, especially for control dimensions such as girder spacing and span lengths. For instance, "2510" or "2500" is preferred over "2512," and "STA. 21 + 25.400" is preferred over "STA. 21 + 25.443."

Decimal places may be added when the sum of rounded-off parts does not equal the overall dimension. For instance, rounded-off span lengths along the outside face of slab on a curved continuous unit sometime do not add up to the continuous unit length. Adding a decimal place to the span lengths will resolve this discrepancy. A 1-mm discrepancy is not considered significant enough to necessitate adding a decimal place.

Adding decimal places is not the answer for reinforcing steel spacing. A nominal spacing should be used whenever possible. It is easy to understand that it would be much easier in the field to place 998 bars at 150 mm spacing rather than 149.9 mm spacing. This can be accomplished by using an odd spacing for the last space at each end and/or the distance from the last bar to the edge of the concrete.

PROFILE GRID

Vertical grid lines shall be shown at 25 or 100 meter intervals, and **horizontal grid lines** shall be shown at 5, 10 or 20 meter intervals, depending on scale.

Show **ground line elevations** at least every 25 meters and at notable grade break points. Interpolate if necessary. Include a note to indicate when elevations are derived from digital terrain modeling or manual interpolation.

SCALES

Two metric scale versions are required with graduations as follows:

Scale 1: 2.5, 5, 10, 20, 50, 100

Scale 2: 100, 200, 300, 400, 500, 600

Scales that can be derived from these graduations represent acceptable scales, with one qualifier; scales used for full-size plans should have corresponding, acceptable, derived scales for half-size plans. For example, a scale of 1:30, which can be derived from the 300 graduation, is acceptable because, at a 50% reduction factor, the scale will become 1:60, which can be derived from the 600 graduation. It follows that scales derived from the 400 and 600 graduations (1:40, 1:60, 1:400, 1:600, 1:4000, 1:6000) are not normally acceptable for full-size plans that are be reduced to half-size because the half-size scales cannot be derived from any of the standard graduations.

In special situations, where normally acceptable scales are impractical, scales derived from the 400 and 600 graduations may be used. In these situations, half-size plan scaling can be achieved by using the full-size scale and doubling the measurement. In addition, since there is a considerable disparity in scale between the 1:10 and 1:20 scales, a scale of 1:15 may be used if necessary. The scale becomes 1:30 at half-size. Full-size scaling is derived by dividing the 1:30 scale reading by 2.

Normally acceptable scales for full-size plans that are to be reduced to half-size are as follows:

Scale graduations:	2.5, 5, 10, 20, 50, 100, 200, 300, 500
Derived scales:	1:1, 1:2, 1:2.5, 1:3, 1:5, 1:10, 1:20, 1:25, 1:30, 1:50, 1:100, 1:200, 1:300, 1:500, 1:1000, 1:2000, 1:2500, 1:3000, 1:5000

Guide for converting English to Metric scale: English scales with their corresponding true scales (in parenthesis) are provided below as an aid in picking the appropriate metric scale. Normally pick the metric scale closest to the true English scale since metric scales are true scales.

Engineers Scale:	10 (1:120), 20 (1:240), 30 (1:360), 40 (1:480), 1:50 (1:600), 60 (1:720)
Architects Scale:	3/32 (1:128), 1/8 (1:96), 3/16 (1:64), 1/4 (1:48), 3/8 (1:32), 1/2 (1:24), 3/4 (1:16), 1 (1:12), 1 1/2 (1:8), 3 (1:4)

SI SYMBOLS

Use standard SI symbols for metric dimensions. Since metric symbols are case sensitive, small characters must be used where applicable for dimension units in the plans (e.g., “50 m”). This is an exception to the “all caps” rule for Bridge Design details.

BID ITEMS

Use standard SI symbols for bid items in detail quantity tables, plan notes and dimensions (e.g., “kg,” “m^3,” etc.).
Spell out quantity units as defined in the Schedule of Bid Items (e.g., “cubic meter”) in the Bridge Master summary table.

STANDARD DETAIL SHEET

The standard detail sheet size shall be 560 x 915 mm (22" x 36"). The border size shall be 530 x 800 mm, which is a reduction in size from the previous standard. This will enable true 50% plotting, which will result in plans that can be scaled. The border shall be centered on the sheet from top to bottom and the right border shall be positioned 13 mm from the right edge of sheet.

SLOPES

Profile grade slopes and roadway cross-slopes shall be expressed in percentage format (e.g., “2.5%”).
Embankment side-slope and revetment fore-slope shall be expressed in ratio format, rise to run (e.g., “1:3”).

ABBREVIATIONS

Commonly used abbreviations, such as PPC, PC, PVI, SSD, GR-200 (M), etc., should be expressed consistently without periods (i.e., "PPC," not "P.P.C.").

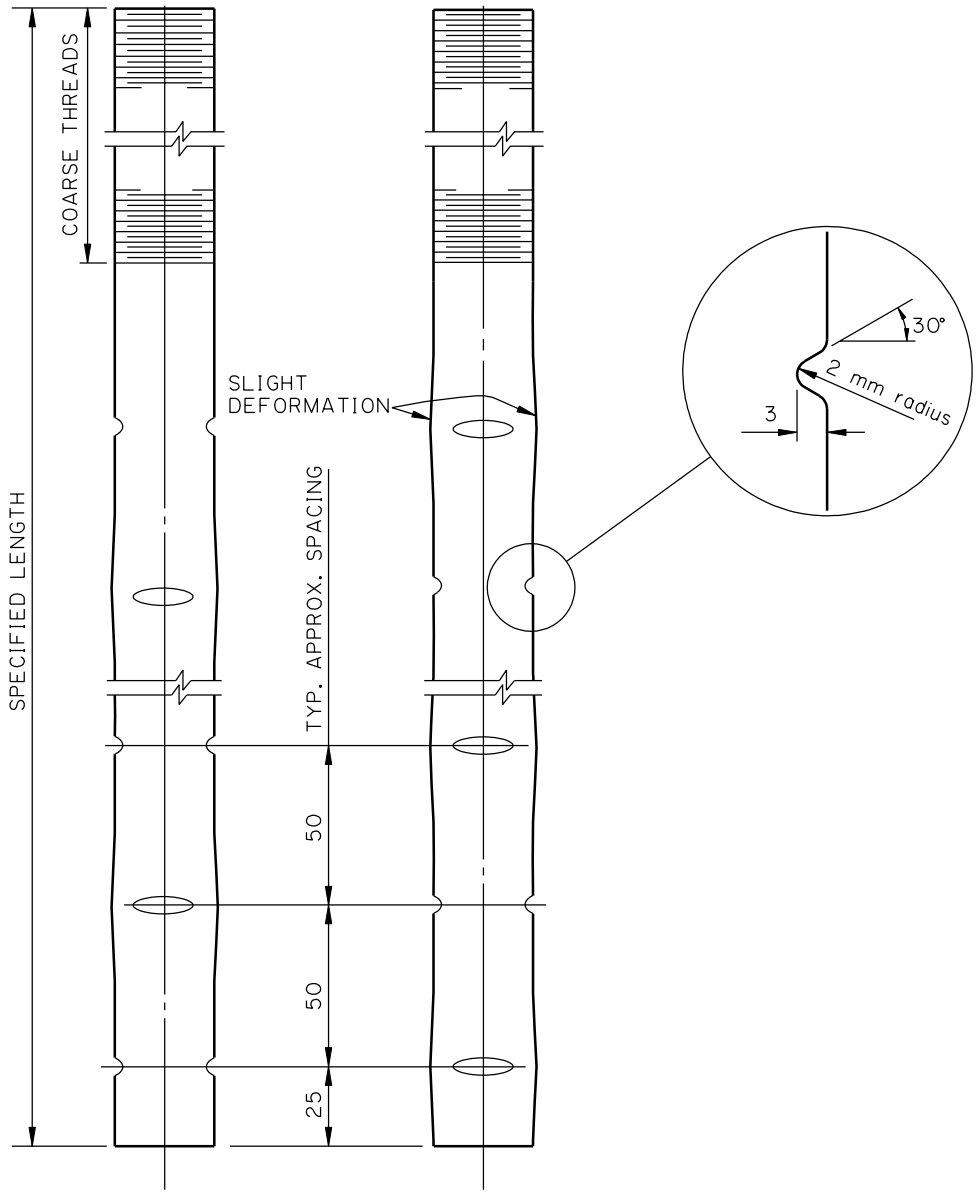
REINFORCING STEEL

Bar designations shall be specified by the prefix "B" followed by the bar size and mark. For example, "B1502" designates a number 15 bar, mark 2.

GENERAL NOTES REGARDING METRIC FORMAT

Include the following statements in the General Notes:
DETAILING CONVENTIONS: DETAIL DIMENSIONS ARE EXPRESSED IN MILLIMETERS (mm) UNLESS OTHERWISE NOTED (E.G., "6000" IMPLIES "6000 mm"). STATIONS AND ELEVATIONS ARE EXPRESSED IN METERS. SCALES SHOWN ARE FOR FULL-SIZE PLANS. DOUBLE THE SCALE GRADUATION FOR HALF-SIZE PLANS. WHERE SCALE IS NOT SHOWN, THE DETAIL IS NOT TO SCALE (NTS). EMBANKMENT SLOPES ARE EXPRESSED AS A RATIO OF RISE TO RUN.

REINFORCING STEEL: ALL REINFORCING STEEL IS DESIGNED AND DETAILED AS METRIC. BAR DESIGNATIONS ARE SPECIFIED WITH THE PREFIX "B" FOLLOWED BY THE BAR SIZE AND MARK. FOR EXAMPLE, "B1502" DESIGNATES A NUMBER 15 BAR WITH A MARK NUMBER OF 2.



PROPOSED METHOD FOR SWEDGING ANCHOR BOLTS

SWEDGED ANCHOR BOLTS

GUIDELINES ON THE COMPUTATIONS OF CONCRETE VOLUME FOR PAYMENT

CONCRETE IS MEASURED AND PAID FOR BY VOLUME IN CUBIC METERS WITH TWO PLACE ACCURACY.

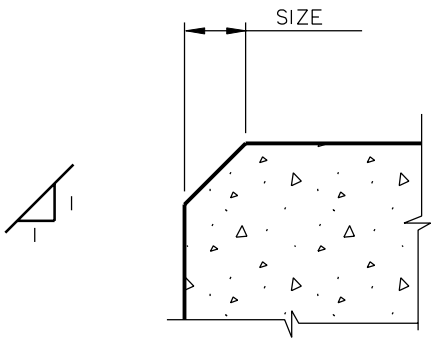
NO DEDUCTIONS ARE TO BE MADE FOR THE VOLUME DISPLACED BY:

1. REINFORCING STEEL
2. STRUCTURAL STEEL PLATES, ANGLES AND APPURTENANCES USED FOR DECK EXPANSION JOINTS AND END DAMS
3. CHAMFERS MEASURING 40 mm OR LESS
4. 150 mm PVC PIPE DRAINS
5. WEEP HOLES, SMALL PIPES AND CONDUITS
6. SHEAR CONNECTORS

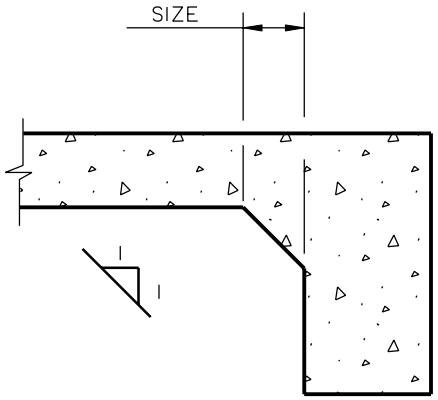
DEDUCTIONS MUST BE MADE FOR VOLUME OF CONCRETE DISPLACED BY:

1. STRUCTURAL STEEL MEMBERS, EXCEPT THOSE LISTED ON ITEM 2 ABOVE
2. CHAMFERS GREATER THAN 40 mm IN SIZE
3. VOLUME OF EMBEDDED PILES (ASSUME A 300 mm BUTT DIAMETER FOR TIMBER PILES)
4. ALL EXPANSION JOINTS

THE COMPUTED VOLUME OF CONCRETE SHALL INCLUDE FILLETS OVER 40 mm IN SIZE.

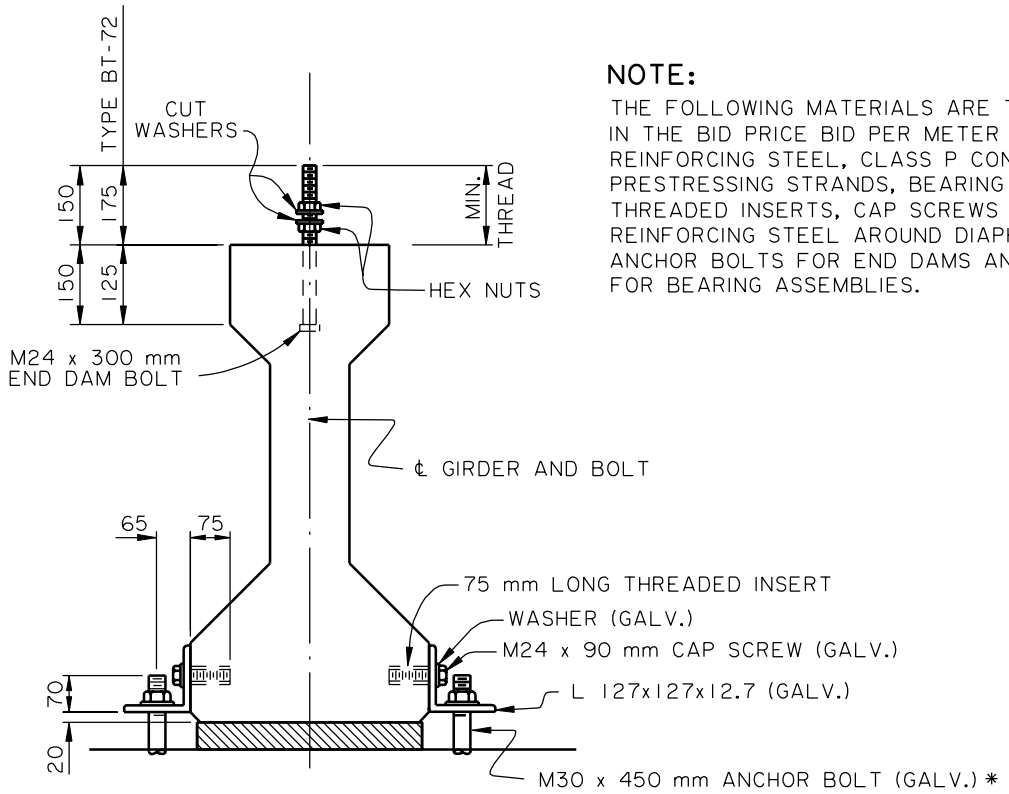


CHAMFER DETAIL



FILLET DETAIL

CONCRETE QUANTITIES MEASUREMENT



GIRDER END VIEW

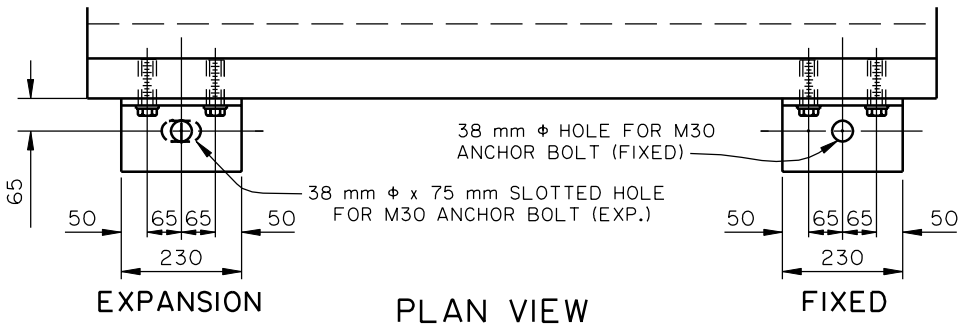
NOTE:

THE FOLLOWING MATERIALS ARE TO BE INCLUDED IN THE BID PRICE BID PER METER OF GIRDER: REINFORCING STEEL, CLASS P CONCRETE, PRESTRESSING STRANDS, BEARING PADS, THREADED INSERTS, CAP SCREWS & WASHERS, REINFORCING STEEL AROUND DIAPHRAGM HOLE, ANCHOR BOLTS FOR END DAMS AND ANGLES FOR BEARING ASSEMBLIES.

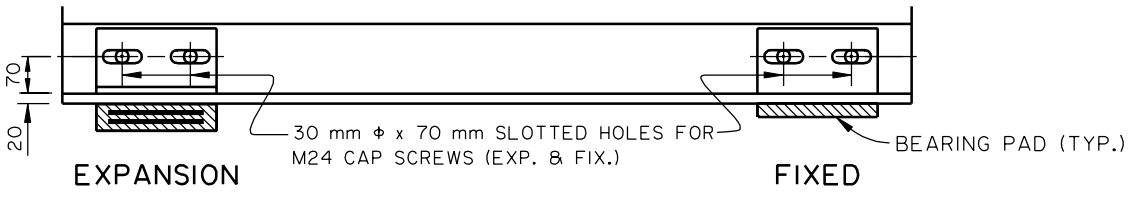
NOTES:

AT THE CONTRACTORS OPTION THE THREADED INSERT MAY BE ELECTRO-PLATED AND COATED WITH GREASE OR GALVANIZED.

* M30 x 450 mm ANCHOR BOLT WITH ONE (1) HEX NUT & ONE (1) WASHER (CLIP FOR NECESSARY CLEARANCE). A DEFORMED REINFORCING BAR OF THE SAME SIZE AND LENGTH MAY BE SUBSTITUTED FOR THIS ANCHOR BOLT. ANCHOR BOLTS TO BE PAID FOR AS STRUCTURAL METALWORK AND INCLUDED IN BENT QUANTITIES (FOR ESTIMATION PURPOSES ONLY).
THE NUMBER OF GIRDERS PER SPAN TO BE ANCHORED VARIES WITH THE SPAN CONFIGURATION.



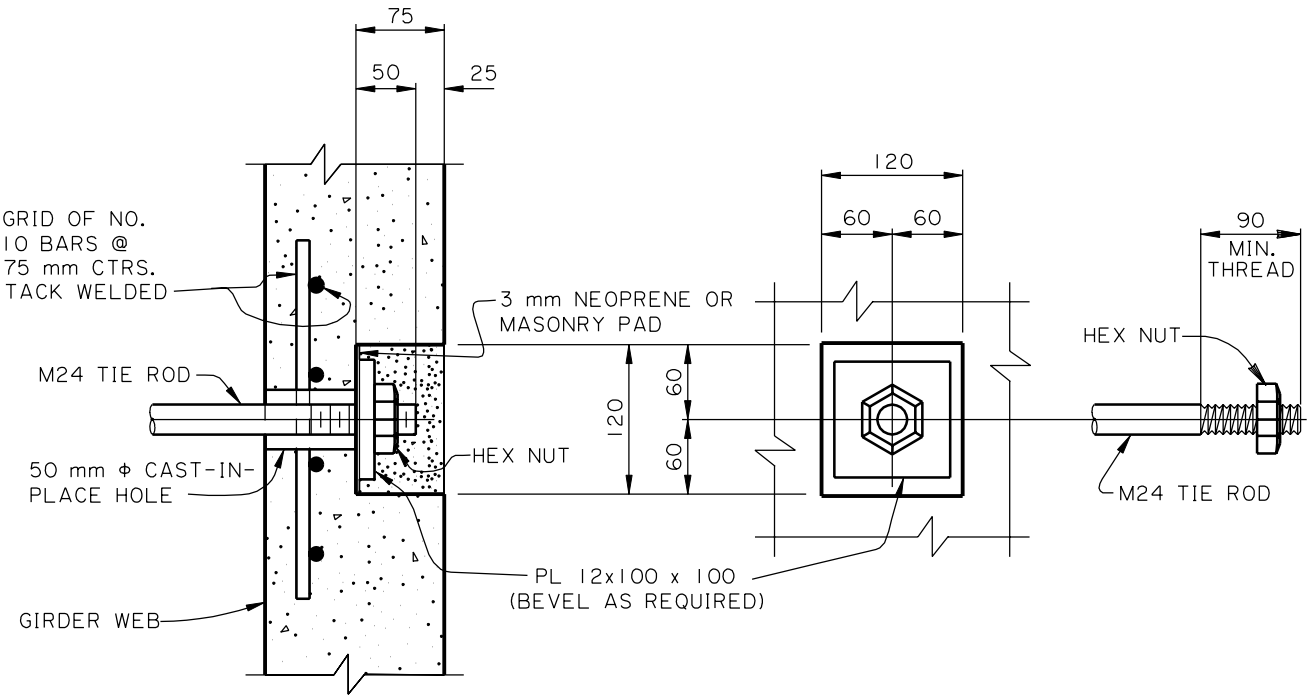
PLAN VIEW



ELEVATION VIEW

GIRDER HARDWARE

Rev. 04/01/99



TIE ROD ASSEMBLY

NOTES:

HAND TIGHTEN NUT AGAINST PLATE BEFORE POURING DIAPHRAGM. AFTER DIAPHRAGM AND SLAB ARE IN PLACE FOR 48 HOURS, TIGHTEN NUT FIRMLY. PAINT ALL EXPOSED SURFACES OF WELL, STEEL PLATE, ROD AND NUT WITH AN APPROVED EPOXY IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND GROUT FLUSH WITH EDGE OF BEAM. (NO DIRECT PAYMENT)

INSIDE FACE OF PL 12x100 x 100 mm SHOULD BE BEVELED AS REQUIRED TO PROVIDE FULL AND EVEN BEARING. IN CASES WHERE EXTERIOR GIRDER IS FLARED, A SECOND BEVEL PLATE MAY BE NEEDED. SHOP DRAWINGS WILL BE REQUIRED FOR ALL CASES.

DIAPHRAGM TIE RODS, NUTS, BEVELED PLATES AND MASONRY PADS ARE TO BE PAID FOR AS STRUCTURAL METALWORK AND INCLUDED IN SPAN QUANTITIES (ESTIMATION PURPOSES ONLY).

GIRDER HARDWARE

2 OF 2

STRUCTURAL METALWORK

APPROACH SLABS:

END DAM PLATE (PL 12x130)	12.25 kg/m
ANCHOR STUDS (M16 x 200 mm)	0.36 kg EACH
CLIP ANGLE (L 203x102x12.7 x 130)	3.80 kg EACH

END BENTS:

ANCHOR BOLTS (STRIP SEAL OR END DAM)

ANCHOR BOLTS (M24 x 510 mm)	1.95 kg EACH
HEX NUTS (2 PER BOLT)	0.18 kg EACH
CUT WASHERS (2 PER BOLT)	0.09 kg EACH

ANCHOR BOLTS (BEARING ASSEMBLY)

ANCHOR BOLTS (M30 x 450 mm)	2.50 kg EACH
HEX NUTS (1 PER BOLT)	0.34 kg EACH
CUT WASHERS (1 PER BOLT)	0.12 kg EACH

INTERMEDIATE BENTS:

ANCHOR BOLTS (BEARING ASSEMBLY)

ANCHOR BOLTS (M30 x 450 mm)	2.50 kg EACH
HEX NUTS (1 PER BOLT)	0.34 kg EACH
CUT WASHERS (1 PER BOLT)	0.12 kg EACH

SPANS:

END DAM ASSEMBLY (WHEN USED)

END DAM PLATE (PL 12x130)	12.25 kg/m
ANCHOR STUDS (M16 x 200 mm)	0.36 kg EACH
CLIP ANGLE (L 152x102x12.7 x 130)	3.13 kg EACH

GIRDERS:

BEARING ASSEMBLY

THREADED INSERTS (2 PER ANGLE)	0.40 kg EACH
CAP SCREWS (M24 x 90 mm) (2 PER ANGLE)	0.40 kg EACH
WASHERS (2 PER ANGLE)	0.09 kg EACH
ANGLE (L 127x127x12.7 x 230)	5.54 kg EACH

ANCHOR BOLTS (STRIP SEAL OR END DAM)

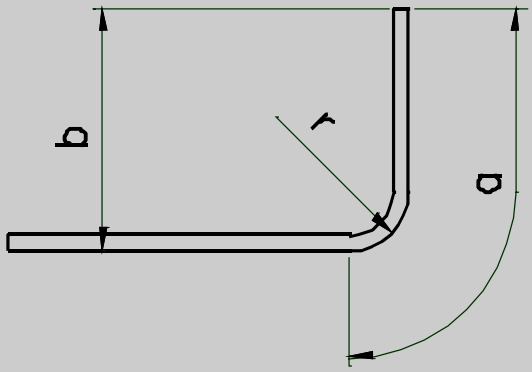
ANCHOR BOLTS (M24 x 300 mm)	1.20 kg EACH
HEX NUTS (2 PER BOLT)	0.18 kg EACH
CUT WASHERS (2 PER BOLT)	0.09 kg EACH

STRUCTURAL METALWORK WEIGHTS (SUMMARY)

Rev. 04/01/99

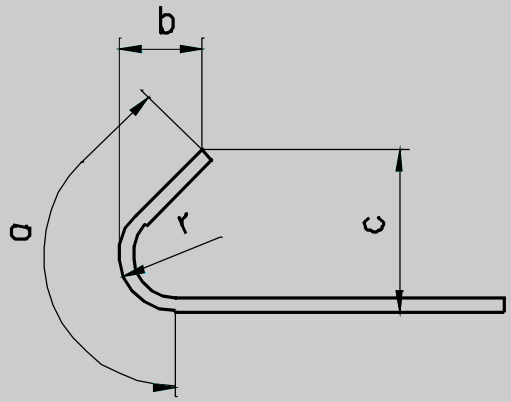
REINFORCEMENT BAR DATA

90 DEGREE HOOK FOR STIRRUPS & TIES (SOFT METRIC)				
BAR SIZE	**PIN DIAMETER**	**RADIUS R**	**a**	**b**
#10	40	30		110
#13	50	40		120
#16	65	50		160
#19	115	80		310
#22	135	90		360
#25	155	100		410
90 DEGREE HOOK FOR STIRRUPS & TIES (HARD METRIC)				
#10	45	35		100
#15	65	50		145
#20	120	80		310
#25	150	100		400



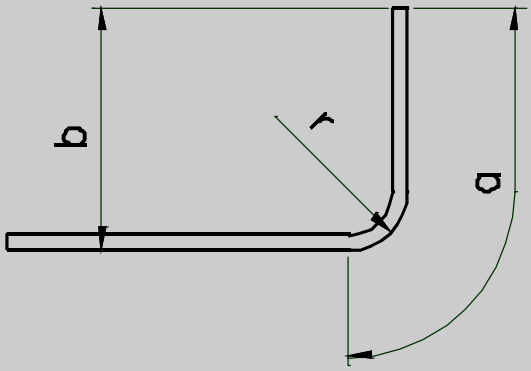
REINFORCEMENT BAR DATA

135 DEGREE HOOK FOR STIRRUPS & TIES (SOFT METRIC)					
BAR SIZE	**PIN DIAMETER**	**RADIUS r**	**a**	**b**	**c**
#10	40	30	125	50	90
#13	50	40	180	65	120
#16	65	49	230	95	160
#19	115	80	310	115	220
#22	135	90	360	130	260
#25	155	100	410	150	300
135 DEGREE HOOK FOR STIRRUPS & TIES (HARD METRIC)					
#10	45	35	150	60	110
#15	65	50	210	85	150
#20	120	80	300	110	220
#25	150	100	400	140	280



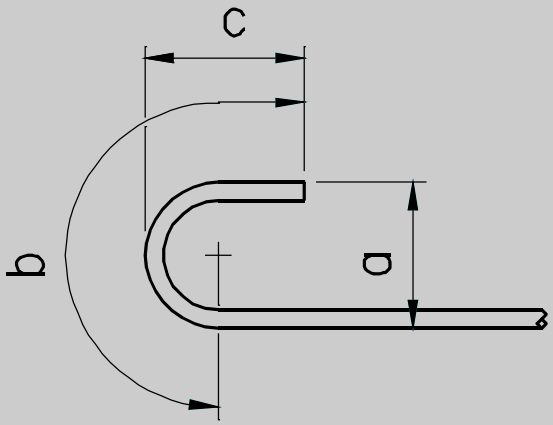
REINFORCEMENT BAR DATA

90 DEGREE STANDARD HOOKS (SOFT METRIC)				
BAR SIZE	**PIN DIAMETER**	**RADIUS R**	**a**	**b**
#10	60	39	170	150
#13	80	53	250	200
#16	95	63	300	250
#19	115	77	350	310
#22	135	89	410	360
#25	155	103	460	410
#29	230	148	570	490
#32	260	160	640	550
#36	290	180	710	610
#43	430	260	920	780
#57	580	350	1230	1030
90 DEGREE STANDARD HOOKS (HARD METRIC)				
#10	70	46	210	180
#15	100	66	300	260
#20	120	80	360	320
#25	150	100	460	400
#30	240	150	590	500
#35	290	180	700	600
#45	440	264	930	780
#55	560	336	1200	1020



REINFORCEMENT BAR DATA

180 DEGREE STANDARD HOOKS (SOFT METRIC)				
BAR SIZE	**PIN DIAMETER**	**a**	**b**	**c**
#10	60	80	190	100
#13	80	110	200	120
#16	95	130	260	130
#19	115	160	320	150
#22	135	180	370	180
#25	155	210	420	200
#29	230	290	570	260
#32	260	330	640	300
#36	290	360	710	330
#43	430	520	990	450
#57	580	690	1310	590
180 DEGREE STANDARD HOOKS (HARD METRIC)				
#10	70	90	200	110
#15	100	130	270	130
#20	120	160	330	160
#25	150	200	420	200
#30	240	300	590	270
#35	290	360	710	320
#45	440	520	1000	440
#55	560	680	1280	560



REINFORCEMENT BAR PROPERTIES (SOFT METRIC)				
BAR SIZE DESIGNATION	**MASS kg/m)**	**DIAMETER (mm)**	**PERIMETER (mm)**	**AREA (mm^2)**
#10	0.560	9.5	29.9	71
#13	0.994	12.7	39.9	129
#16	1.552	15.9	49.9	199
#19	2.235	19.1	59.8	284
#22	3.042	22.2	69.8	387
#25	3.973	25.4	79.8	510
#29	5.060	28.7	90.0	645
#32	6.404	32.3	101.3	819
#36	7.907	35.8	112.5	1006
#43	11.380	43.0	135.1	1452
#57	20.240	57.3	180.1	2581

REINFORCEMENT BAR PROPERTIES (HARD METRIC)				
BAR SIZE DESIGNATION	**MASS kg/m)**	**DIAMETER (mm)**	**PERIMETER (mm)**	**AREA (mm^2)**
#10	0.785	11.3	35.5	100
#15	1.570	16.0	50.3	200
#20	2.355	19.5	61.3	300
#25	3.925	25.2	79.2	500
#30	5.495	29.9	93.9	700
#35	7.850	35.7	112.2	1000
#45	11.775	43.7	137.3	1500
#55	19.625	56.4	177.2	2500

BOLT DATA

BOLT PROPERTIES FOR METRIC BOLTS AND ENGLISH BOLT SUBSTITUTIONS					
Metric Bolt Designation	Diameter (mm)	Area (mm^2)	**English Bolt Designation**	Diameter (mm)	Area (mm^2)
M16	16	201.1	**5/8"**	15.9	197.9
M20	20	314.2	**None**	N/A	N/A
M22	22	380.1	**7/8"**	22.2	387.9
M24	24	452.4	**1"**	25.4	506.7
M27	27	572.6	**1 1/8"**	28.6	641.3
M30	30	706.9	**1 ¼"**	31.8	791.7
M36	36	1017.9	**1 ½"**	38.1	1140.1
M48	48	1809.6	**2"**	50.8	2026.8
M64	64	3217.0	**2 ½"**	63.5	3166.9
M72	72	4071.5	**3"**	76.2	4560.4

English bolts may be substituted for metric bolts as per the above table with the provision that, if any metric (A 325M) bolt is substituted for with the English (A 325) bolt, then all high-strength bolts shall be A 325. When substitutions are made, bolt hole size, minimum pitch and minimum clear distances shall be adjusted as required. Substitutions shall be at no additional cost to the Department.

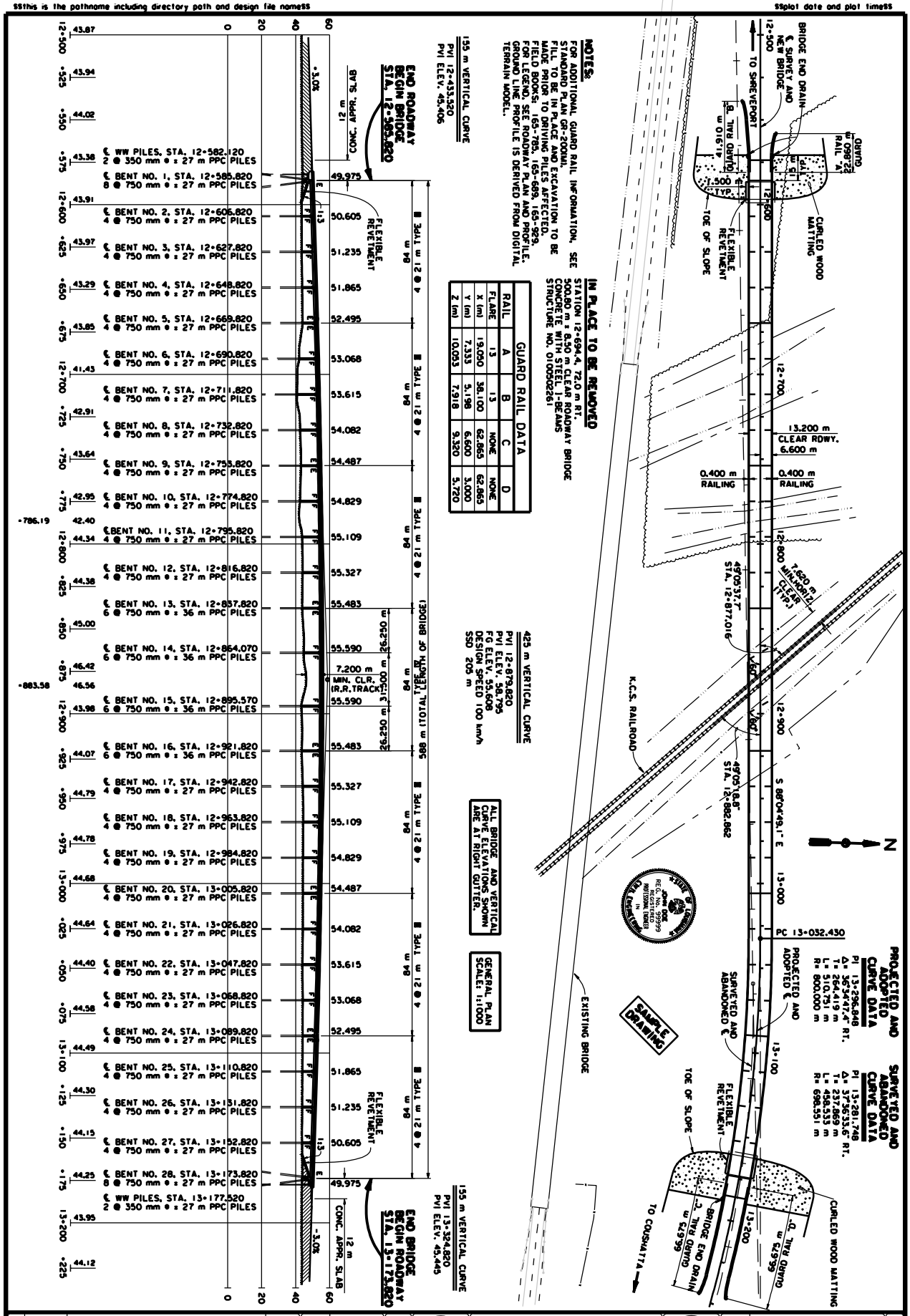
BOLT EDGE DISTANCES				
Minimum Edge Distances (From AASHTO LRFD for M16-M36 Bolts)			**Edge Distance Computation for Detailing - Rule of Thumb (Apply Multiplier to Diameter)**	
Metric Bolt Designation	Sheared Edges (mm)	Rolled or Gas Cut Edges (mm)	Sheared Edges (Multiplier)	Rolled or Gas Cut Edges (Multiplier)
M16	29	22	2.0	1.5
M20	32	25	2.0	1.5
M22	38	29	2.0	1.5
M24	44	32	2.0	1.5
M27	54	38	2.0	1.5
M30	57	41	2.0	1.5
M36	60	44	1.75	1.25
M48	84	60	1.75	1.25
M64	112	80	1.75	1.25
M72	126	90	1.75	1.25

BOLT HOLE DIMENSIONS FOR METRIC BOLTS				
Bolt Designation	Standard Diameter (mm)	Oversize Diameter (mm)	Short-Slot Width x Length (mm)	Max. Long-Slot Width x Length (mm)
M16	18	20	18 x 22	18 x 40
M20	22	24	22 x 26	22 x 50
M22	24	28	24 x 30	24 x 55
M24	26	30	26 x 32	26 x 60
M27	29	35	29 x 37	29 x 67
M30	32	38	32 x 40	32 x 75
M30 *	N/A	38	N/A	38 x 75
M36 *	N/A	44	N/A	44 x 90
M48 *	N/A	56	N/A	56 x 120
M64 *	N/A	74	N/A	74 x 160
M72 *	N/A	82	N/A	82 x 180
* Anchor bolts				

BOLT HOLE DIMENSIONS FOR ENGLISH BOLT SUBSTITUTIONS				
Bolt Designation	Standard Diameter (mm)	Oversize Diameter (mm)	Short-Slot Width x Length (mm)	Max. Long-Slot Width x Length (mm)
5/8”	18	20	18 x 22	18 x 40
7/8”	24	28	24 x 30	24 x 55
1”	27	31	27 x 33	27 x 60
1 1/8”	31	35	31x 37	31 x 67
1 ¼”	34	40	34 x 42	34 x 75
1 ¼” *	N/A	40	N/A	40 x 75
1 ½” *	N/A	46	N/A	46 x 90
2” *	N/A	59	N/A	59 x 120
2 ½” *	N/A	74	N/A	74 x 160
3” *	N/A	86	N/A	86 x 180
* Anchor bolts				

COMMON AND PREFERRED STEEL PLATE THICKNESSES

Common Plate Thicknesses	
Metric (mm)	**Equivalent (in)**
5	0.20
5.5	0.22
6	0.24
7	0.28
8	0.32
9	0.35
10	0.39
11	0.43
12	0.47
14	0.55
16	0.63
18	0.71
20	0.79
22	0.87
25	0.98
28	1.10
30	1.18
32	1.26
35	1.38
38	1.50
40	1.57
45	1.77
50	1.97
55	2.17
60	2.36
10 mm increments above 60 mm 50 mm increments above 200 mm	
Preferred thicknesses are shaded.	



NO.	DATE	REVISION DESCRIPTION	BY

DESIGNED
CHECKED
DETAILED M. WARD
CHECKED
DATE 2-25-97
SHEET

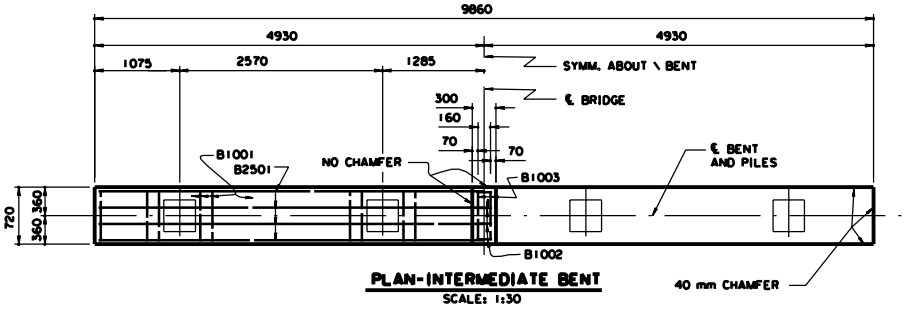
BRIDGE AND STRUCTURAL DESIGN

K.C.S. RAILROAD OVERPASS
(NINOCK)
US 71

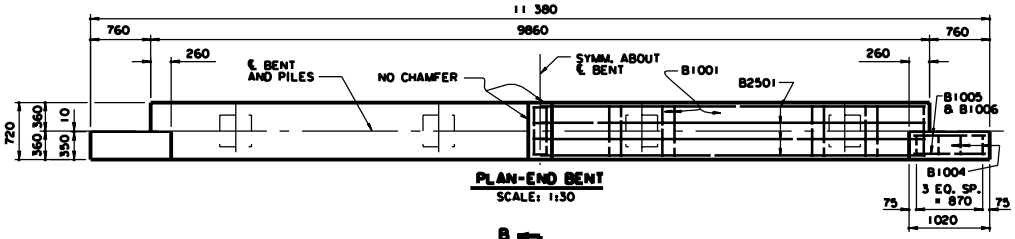
BRIDGE LAYOUT GENERAL PLAN

PARISH BOSSIER
FEDERAL PROJECT 37-071018
STATE PROJECT 010-05-0027

SHEET NUMBER 103



PLAN-INTERMEDIATE BENT
SCALE: 1:30



PLAN-END BENT
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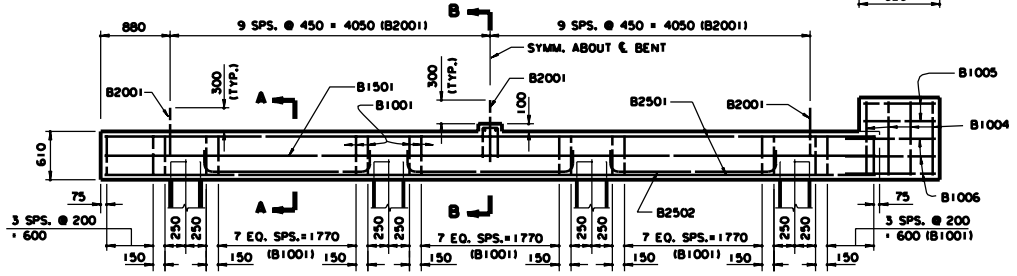
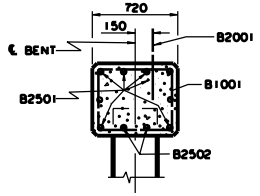
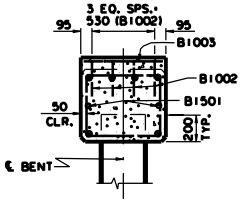


HALF ELEVATION (INTERMEDIATE BENT)
SCALE: 1:30

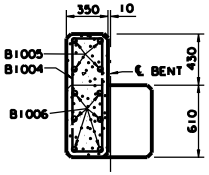
HALF ELEVATION (END BENT)
SCALE: 1:30



SECTION A-A
SCALE: 1:20



SECTION B-B
SCALE: 1:20



END ELEVATION
SCALE: 1:20

BENT NOTES:

CONSTRUCTION SPECIFICATIONS: LATEST APPROVED LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, SUPPLEMENTAL SPECIFICATIONS AND SPECIAL PROVISIONS.

DESIGN SPECIFICATIONS: AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 1992, AND INTERIM SPECIFICATIONS.

DESIGN LOAD: LIVE LOAD IS HS20-44(M) AND HST-18(M).

STRUCTURAL CONCRETE: ALL CONCRETE SHALL BE CLASS A. EXPOSED EDGES SHALL HAVE A 20 mm CHAMFER UNLESS OTHERWISE NOTED. ALL EXPOSED FACES OF WINGWALLS AND ENDS OF CAPS SHALL RECEIVE A CLASS 2A SPECIAL SURFACE FINISH. ASPHALT SATURATED FELT SHALL BE INCLUDED IN THE PRICE BID FOR CLASS A CONCRETE.

REINFORCING STEEL: ALL REINFORCING STEEL SHALL BE GRADE 400.
DIMENSIONS RELATING TO BAR FABRICATION ARE OUT-TO-OUT OF BAR UNLESS OTHERWISE NOTED.
DIMENSIONS RELATING TO BAR SPACING ARE TO BAR CENTERS, UNLESS OTHERWISE NOTED.
DOWELS (B2001) SHALL BE PROVIDED AT ALL FIXED BEARINGS AND APPROACH SLAB BEARINGS (SEE GENERAL PLAN).
ALL EXPOSED ENDS OF DOWELS SHALL BE WRAPPED WITH TWO LAYERS OF TYPE I (NO.15) ASPHALT SATURATED FELT. CLOSE FITTING TUBES OF COMPRESSIBLE MATERIAL, NOT LESS THAN 5 mm THICK, MAY BE SUBSTITUTED.

PRECAST CONCRETE PILES: FOR DETAILS OF PILES SEE STANDARD DETAIL CS-216(M).

ESTIMATED QUANTITIES (ONE INTER. BENT)

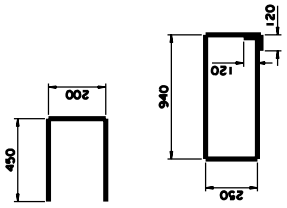
BAR	NO.	UNIT LENGTH	TOTAL LENGTH	LOCATION
B2501	6	9 760	58 560	LONGITUDINAL IN CAP
B2502	6	2 830	16 980	LONGITUDINAL IN CAP
TOTAL NO. 25 BARS = 75 540 = 296 kg				
B2001	19	600	11 400	DOWELS
TOTAL NO. 20 BARS = 11 400 = 27 kg				
B1501	2	9 760	19 520	LONGITUDINAL IN CAP
TOTAL NO. 15 BARS = 19 520 = 31 kg				
B1001	40	2 500	100 000	STIRRUPS IN CAP
B1002	4	1 100	4 400	STIRRUPS IN RISER
B1003	2	620	1 240	LONGITUDINAL IN RISER
TOTAL NO. 10 BARS = 105 640 = 83 kg				
TOTAL DEFORMED REINFORCING STEEL = 437 kg				
TOTAL CLASS A CONCRETE = 4,20 m³				
MAXIMUM PILE LOAD = 430 kN				

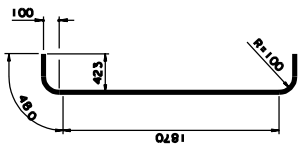
• ADD 27 kg REINFORCING STEEL (19 B2001 DOWELS) WHEN TWO FIXED ENDS OCCUR ON THE SAME BENT

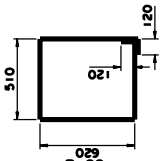
ESTIMATED QUANTITIES (ONE END BENT)

BAR	NO.	UNIT LENGTH	TOTAL LENGTH	LOCATION
B2501	6	9 760	58 560	LONGITUDINAL IN CAP
B2502	6	2 830	16 980	LONGITUDINAL IN CAP
TOTAL NO. 25 BARS = 75 540 = 296 kg				
B2001	19	600	11 400	DOWELS
TOTAL NO. 20 BARS = 11 400 = 27 kg				
B1501	2	9 760	19 520	LONGITUDINAL IN CAP
TOTAL NO. 15 BARS = 19 520 = 31 kg				
B1001	40	2 500	100 000	STIRRUPS IN CAP
B1002	4	1 100	4 400	STIRRUPS IN RISER
B1003	2	620	1 240	LONGITUDINAL IN RISER
B1004	8	2 600	20 800	STIRRUPS IN WINGWALL
B1005	8	920	7 360	LONGITUDINAL IN WINGWALL
B1006	12	1 200	14 400	LONGITUDINAL IN WINGWALL
TOTAL NO. 10 BARS = 148 200 = 116 kg				
TOTAL DEFORMED REINFORCING STEEL = 470 kg				
TOTAL CLASS A CONCRETE = 4,84 m³				
MAXIMUM PILE LOAD = 430 kN				

• 400 mm • PPC PILES ARE USED FOR ESTIMATING PURPOSES ONLY. IF 350 mm • PPC PILES ARE USED, ADD 0.04 m³ OF CLASS A CONCRETE PER BENT.







STATE OF LOUISIANA
JOHN DOE
REG. No. 99999
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING

SAMPLE DRAWING

SHEET NUMBER

PARISH | FEDERAL PROJECT | STATE PROJECT

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

CAST-IN-PLACE CONCRETE BENT
9 m CLEAR ROADWAY
90° CROSSING

STANDARD DETAIL | dp-BCSSBR-90-9-TBT-6L

BRIDGE AND STRUCTURAL DESIGN

DESIGNED | CHECKED | DETAILED | CHECKED | DATE | SHEET
2-25-97 | 1 OF 2

NO. | DATE | REVISION DESCRIPTION | BY

9 (37)

DEVELOPMENT LENGTH OF REINFORCING BARS IN TENSION, (mm)[1]

[2]Bar No.	f'c = 22 MPa, class A, S, X						f'c = 24 MPa, class AA, S, X				
	ld[3]	1.3ld	1.4ld	1.7ld	2.0ld		ld	1.3ld	1.4ld	1.7ld	2.0ld
10M	300	370	400	490	570		300	370	400	490	570
15M	410	540	580	700	820		410	540	580	700	820
20M	540	710	760	920	1080		520	680	730	890	1040
25M	900	1170	1260	1530	1800		860	1120	1210	1470	1720
30M	1260	1640	1770	2150	2520		1210	1580	1700	2060	2420
35M	1800	2340	2520	3060	3600		1720	2240	2410	2930	3440
45M	2240	2920	3140	3810	4480		2150	2800	3010	3660	4300
55M	3050	3970	4270	5190	6100		2920	3800	4090	4970	5840

Bar No.	f'c = 26 MPa, class AA(M), A(M)						f'c = 18 MPa, class D				
	ld	1.3ld	1.4ld	1.7ld	2.0ld		ld	1.3ld	1.4ld	1.7ld	2.0ld
10M	300	370	400	490	570		300	370	400	490	570
15M	410	540	580	700	820		410	540	580	700	820
20M	500	650	700	850	1000		600	780	840	1020	1200
25M	830	1080	1170	1420	1660		990	1290	1390	1690	1980
30M	1160	1510	1630	1980	2320		1390	1810	1950	2370	2780
35M	1650	2150	2310	2810	3300		1980	2580	2780	3370	3960
45M	2480	3230	3480	4220	4960		2970	3870	4160	5050	5940
55M	4120	5360	5770	7010	8240		4950	6440	6930	8420	9900

Bar No.	f'c = 45MPa, class P(M)						F'c = 40 MPa, class P				
	ld	1.3ld	1.4ld	1.7ld	2.0ld		ld	1.3ld	1.4ld	1.7ld	2.0ld
10M	300	370	400	490	570		300	370	400	490	570
15M	410	540	580	700	820		410	540	580	700	820
20M	500	650	700	850	1000		500	650	700	850	1000
25M	640	840	900	1090	1280		670	880	940	1140	1340
30M	880	1150	1240	1500	1760		930	1210	1310	1590	1860
35M	1260	1640	1770	2150	2520		1330	1730	1870	2270	2660
45M	1880	2450	2640	3200	3760		2000	2600	2800	3400	4000
55M	3140	4090	4400	5340	6280		3330	4330	4670	5670	6660

[1] For epoxy reinforcing development length, see AASHTO LFD specs 8.25.2.3
[2] ASTM A 615M-95b (fy = 420 MPa)
[3] Refer to LRFD 5.11.2.1.1 for development of reinforcing